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(54) Antimicrobially Active Non-Woven Web Used in a Wet Wiper

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An Antimicrobially Active Non-Woven Web Used In A Wet Wiper

The present invention relates to non-woven webs, and, more particularly, to antimicrobially active, non-woven webs, to wet wipers containing such a web, and to a method of making the web.

Wet wiper products, including those utilizing non-woven and air-laid webs, require antimicrobial properties to destroy or inhibit the growth of various microorganisms, bacteria, yeasts, and molds. Presently, there are at least four methods of treating the fabric of the wet wiper product to obtain some type of antimicrobial protection - sterilization; pore size control, such as Bacterial Filtration Efficiency (BFE); chemical surface treatment; and overall chemical protection. All of these methods have demonstrated inherent deficiencies for wet wiper products.

Sterilization may be achieved by sterilizing the raw materials going into the make-up of the product and/or sterilizing the final packaged product. Sterilization is an excellent technique for killing the microorganisms present to provide a microbiologically clean product for the intended use. However, in the case of wet wipers, sterilization as an antimicrobial technique is limited because once the product package has been opened to dispense the wipers, the sterilization is voided and any

remaining wipers are exposed to and therefore subject to microbiological growth. As a result, the product is rendered both useless and potentially harmful.

Therefore, sterilization is viable only for single use packages of wet wipers. Nevertheless, due to shelf life and package integrity concerns, all single use wet wipers packages commercially available still rely on additional chemical protection for good microbiological control.

Fabric pore size control by BFE can be used to control the passage of microorganisms from one side or surface of the fabric through the fabric to the other side or surface. Pore size control as a method of microbiological transport control is generally used only with a dry fabric and is found most frequently in the medical industry in such products as CSR wraps and face masks. This method of microorganism transport control is ineffective for use in a wet wiper, because any microorganisms present can pass entirely around the fabric in the liquid or lotion phase of the product.

Antimicrobial surface treatment of a fabric may also be beneficial in the dry mode of usage, where, along with the pore size control by BFE, microorganisms are either filtered out and/or killed upon contact with the surface of the fabric. However, again in the case of wet wipers, surface treatment of the fabric has been shown to be insufficient to obtain the necessary microbiological control. The liquid or lotion phase of the wet wiper product penetrates into the interstices of the fabric to carry the microorganisms past the treated surface into the interstices of the fabric, where they may then grow and multiply.

Virtually the only method of antimicrobial control and protection presently used in wet wiper products is that which is achieved by a chemical permeation of preservative agents throughout the wet wiper product. This permeation may be achieved by padding the wiper fabric during its

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manufacture and/or by incorporating the chemicals in the liquid or lotion phase of the wiper product.

Padding the fabric is generally not used as a commercial technique because of the additional manufacturing processing costs. Since a liquid or lotion must be applied to the fabric anyway in a wet wiper product, and since the liquid or lotion without antimicrobial control or preservation agents represents a key opportunity for microbiological growth, the preferred method of applying the chemical preservation or antimicrobial control is t incorporate the soluble preservative agents in the lotion phase and then apply the preserved lotion to the fabric.

In either case, the end result is the same. Since the preservatives and antimicrobial agents are soluble in a liquid or lotion phase, they ultimately equilibrate throughout the wet wiper product and provide a homogenous chemical method of antimicrobial control. Unfortunately, when a wet wiper product of this type is ultimately used, the preservatives or antimicrobial agents remain behind on the user's skin from the liquid or lotion phase and leave an irritating residue on the skin. Many individuals exhibit adverse reactions to such preservatives, and hence, their enjoyable use of the wet wiper product is significantly impeded.

Moreover, both chemical solubility and antimicrobial spectrum activity considerations significantly limit the use of other, less harsh preservative in the liquid wetting solution. Consequently, the present use of wet wiper products, such as those that use non-woven webs, has numerous inherent disadvantages.

Therefore, it would be desirable to incorporate the antimicrobial properties required in the wet wiper product in a manner substantive to and within the wet wiper fabric. In this manner, the issues of chemical solubility and antimicrobial activity considerations could be overcome because

no harmful residue would be left on the skin of the user. In addition, the increased costs of padding the wet wiper fabric during its manufacturing process could be overcome by incorporating these substantive antimicrobials into the synthetic bonding agent typically already required for such non-woven fabrics.

In sum, present non-woven web products that exhibit antimicrobial activity are less than satisfactory. Often, the webs contain preservatives that leave an irritating residue on the user's skin. Moreover, the use of various synthetic fibers and off-line treatment processes increase the cost of producing these non-woven web products.

SUMMARY OF THE INVENTION

Quite surprisingly, the inventor of the present invention has developed an antimicrobially active, non-woven web that overcomes the significant and inherent disadvantages present in previous non-woven webs that attempt to exhibit antimicrobial and wet wiper properties. Unlike previous webs, the non-woven web of the present invention need not be maintained in a preservative containing solution that contains irritating chemical and leaves harmful residues on the skin of the user. Moreover, the present invention utilizes currently existing and preferred processing techniques for application of the substantive antimicrobial agent, thereby reducing the cost of manufacture.

The present invention achieves these various advantages by providing a method for making an antimicrobially active, non-woven web. The method comprises the steps of: (a) forming an unbonded fibrous web; (b) applying throughout the unbonded fibrous web an uncured binder and an antimicrobial agent, the antimicrobial agent being substantive to the fibers of the web and to the binder when the web is either wet or dry; and (c) curing the binder to bind the fibers together to form an antimicrobially active, non-

woven web. Preferably, the antimicrobial agent is an organo-silicon quaternary ammonium salt, such as a silyl-quaternary ammonium salt. Particularly preferred antimicrobial agents are 3-(trimethoxysilyl) propyldidecyl-methyl ammonium salt and 3-(trimethoxysilyl) propyloctadecyldimethyl ammonium salt. Other such substantive antimicrobial agents may be recognized by those familiar with the art.

The antimicrobially active, non-woven web formed by the present invention comprises: (a) bonded fibers; (b) a binder substantially uniformly distributed on the fibers, the binder being present in an amount effective to bind the fibers; and (c) an antimicrobial agent substantially uniformly distributed on the fibers, the antimicrobial agent being substantive to the fibers and to the binder when the web is either wet or dry.

These non-woven webs can be used to form an antimicrobially active, wet wiper that comprises: (a) an antimicrobially active, non-woven web as defined above and (b) a substantially preservative free liquid in which the web is maintained in wet condition until use.

The present invention overcomes the numerous inherent disadvantages commonly associated with previous antimicrobially active non-woven webs and obtains the various advantages of the invention. By no longer requiring the presence of a preservative in the surrounding solution, the non-woven web product of the present invention avoids leaving an irritating residue on the user's skin. Consequently, the present invention significantly advances over the state of the art.

The foregoing and other features and advantages of the present invention will be made more apparent from the following description of the preferred embodiments.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The method of the present invention produces an antimicrobially active, non-woven web. Initially, the present method forms an unbonded fibrous web. An uncured

TABLE NO. 1

	Day 1	Inoculum level/gram	Average
	An	3.3 X 10^4/g	267/g
	Ca	3.3 X 10^4/g	<33/g
	Sa	2.3 X 10^6/g	<33/g
	Pa	4.7 X 10^5/g	33/g
	Ec	4.7 X 10^5/g	<33/g
	WEEK 1		
	An		33/g
	Ca		<33/g
	Sa		<33/g
	Pa		<33/g
	Ec		<33/g
	WEEK 2		
	An		<33/g
	Ca		<33/g
	Sa		<33/g
	Pa		<33/g
	Ec		<33/g
	WEEK 3		
	An		<33/g
	Ca		<33/g
	Sa		<33/g
	Pa		<33/g
	Ec		<33/g
	WEEK 4 Plated:		
	An		<33/g
	Ca		<33/g
	Sa		33/g
	Pa		33/g
	Ec		33/g

The preservative is considered effective in the product examined if: (a) the concentration of viable bacteria is reduced to not more than 0.1 % of the initial concentrations by the fourteenth day; (b) the concentrations of viable yeasts and molds remain at or below the initial concentrations during the first fourteen days; and (c) the concentration of each test microorganism remains at or below these designated levels during the remainder of the 28 day test period.

All five microorganisms reduced in numbers by a factor of 10^4 or more. Accordingly, the antimicrobial activity

of the towellettes was rated as being excellent.

Other embodiments of the invention will be apparent to one skilled in the art from a consideration of the specification or with the practice of the invention disclosed herein. It is intended that the specification and example be considered as exemplary only with the true scope and spirit of the invention being indicated by the claims.

Claims:

1. A method for making an antimicrobially active, non-woven web comprising the steps of:

(a) forming an unbonded fibrous web;

(b) applying throughout the unbonded fibrous web an uncured binder and an antimicrobial agent, the antimicrobial agent being substantive to the fibers of the web and to the binder when the web is either wet or dry; and

(c) curing the binder to bind the fibers together to form an antimicrobially active, non-woven web.

2. The method of claim 1, wherein the fibers are selected from the group consisting of cellulosic fibers, synthetic fibers, and combinations thereof.

3. The method of claim 1, wherein the antimicrobial agent is an organo-silicon quaternary ammonium salt.

4. The method of claim 3, wherein the organo-silicon quaternary ammonium salt from the group consisting of 3-(trimethoxysilyl) propyldidecylmethyl ammonium salt and 3-(trimethoxysilyl) propyloctadecyldimethyl ammonium salt.

5. The method of Claim 4, wherein the salt has a chloride anion.

6. The method of claim 1, wherein the binder is a polymeric binder.

7. The method of claim 6, wherein the polymeric binder is a latex binder.

8. The method of claim 1, wherein the amount of the antimicrobial agent applied to the web is in the range of about 0.25 % to about 3 % of the total web weight.

9. The method of claim 1, wherein the amount of the binder applied to the web is in the range of about 5 % to about 30 % of the total web weight.

10. The method of claim 1, wherein the antimicrobial agent is safe for contact with human skin and eyes.

11. The method of claim 1, wherein the unbonded fibrous web is formed by air-laying.

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12. The method of claim 1, wherein the unbonded fibrous web is formed by wet-laying.

13. A method for making an antimicrobially active, air-laid non-woven web comprising the steps of:

(a) air laying an unbonded cellulosic fiber web,

(b) applying throughout the unbonded cellulosic fiber web an uncured polymeric binder and an antimicrobial agent, the antimicrobial agent being an organo-silicon quaternary ammonium salt substantive to the cellulosic fibers of the web and to the polymeric binder when the web is either wet or dry; and

(c) curing the binder to bind the cellulosic fibers together to form an antimicrobially active, air-laid, non-woven web.

14. The method of claim 13, wherein the organo-silicon quaternary ammonium salt is selected from the group consisting of 3-(trimethoxysilyl) propyldidecylmethyl ammonium salt and 3-(trimethoxysilyl) propyloctadecyldimethyl ammonium salt.

15. The method of claim 14, wherein the salt has a chloride anion.

16. The method of claim 13, wherein the amount of the organo-silicon quaternary ammonium salt applied to the web is in the range of about 0.25 % to about 3 % of the total web weight.

17. The method of claim 13, wherein the amount of the binder applied to the web is in the range of about 5 % to about 30 % of the total web weight.

18. The method of claim 13, wherein the antimicrobial agent is safe for contact with human skin and eyes.

19. An antimicrobially active, non-woven web comprising:

(a) bonded fibers;

(b) a binder substantially uniformly distributed on the fibers, the binder being present in an amount effective to bind the fibers; and

(c) an antimicrobial agent substantially uniformly distributed on the fibers, the antimicrobial agent being substantive to the fibers and to the binder when the web is either wet or dry.

20. The web of claim 19, wherein the fibers are selected from the group consisting of cellulosic fibers, synthetic fibers, and combinations thereof.

21. The web of claim 19, wherein the binder is a polymeric binder.

22. The web of claim 21, wherein the polymeric binder is a latex binder.

23. The web of claim 19, wherein the antimicrobial agent is an organo-silicon quaternary ammonium salt.

24. The web of claim 23, wherein the organo-silicon quaternary ammonium salt is selected from the group consisting of a 3-(trimethoxysilyl) propyldidecylmethyl ammonium salt and 3 (trimethoxysilyl) propyloctadecyldimethyl ammonium salt.

25. The web of claim 24, wherein the salt has a chloride anion.

26. The web of claim 19, wherein the amount of the antimicrobial agent is in the range of 0.25 % to about 3 % of the total web weight.

27. The web of claim 19, wherein the amount of the binder is in the range of about 5 to about 30 % of the total web weight.

28. The web of claim 19, wherein the antimicrobial agent is safe for contact with human skin and eyes.

29. The web of claim 19, wherein the bonded fibers are air-laid.

30. The web of claim 19, wherein the bonded fibers are wet-laid.

31. An antimicrobially active wet wiper comprising:

(a) an antimicrobially active non-woven web comprising:

(i) bonded fibers;

(ii) a binder in an amount effective to bind the fibers;

(iii) an antimicrobial agent being substantive to the fibers and to the binder when the web is either wet or dry; and

(b) a substantially preservative free liquid in which the web is maintained in a wet condition until use.

32. The wet wiper of claim 31, wherein the fibers are selected from the group consisting of cellulosic fibers, synthetic fibers, and combinations thereof.

33. The wet wiper of claim 31, wherein the binder is a polymeric binder.

34. The wet wiper of claim 31, wherein the antimicrobial agent is an organo-silicon quaternary ammonium salt.

35. The wet wiper of claim 34, wherein the organo-silicon quaternary ammonium salt is selected from the group consisting of a 3-(trimethoxysilyl) propyldidecylmethyl ammonium salt and 3-(trimethoxysilyl) propyloctadecyldimethyl ammonium salt.

36. The wet wiper of claim 35, wherein the salt has a chloride anion.

37. The wet wiper of claim 31, wherein the substantially preservative free liquid is water.

38. The wet wiper of claim 31, wherein the fibers are air-laid.

39. The wet wiper of claim 31, wherein the fibers are dry-laid.